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How Does Technology Integration Enhance Teachers' Competence in Implementing the "Merdeka Curriculum"?

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Abstract

The implementation of the Merdeka Curriculum in elementary schools still faces challenges, including limited infrastructure, pedagogical preparedness, and low levels of teachers' digital literacy, resulting in suboptimal use of educational technology. This study aims to analyze the improvement of teachers' competence in utilizing technology as part of the Merdeka Curriculum policy implementation at public elementary schools in the Duren Sawit area, West Jakarta. The research employed a descriptive qualitative approach combined with action research through planning, implementation, observation, and reflection stages. Data were collected through interviews, classroom observations, documentation, and pre-test and post-test assessments, which were analyzed using the N-gain calculation. The findings indicate a significant increase in teachers' digital competence, with the average score rising from 42.1 in the pre-test to 81.9 in the post-test, and an N-gain score of 68.5%, categorized as effective. This improvement is reflected in teachers' enhanced ability to design digital media, utilize social media as a learning platform, and integrate technology into project-based learning assessments. The results conclude that strengthening digital literacy through continuous training and collaborative mentoring plays an essential role in supporting the successful implementation of the Merdeka Curriculum. This study contributes to the development of technology-based teacher competence improvement practices and enriches the discourse on digital readiness in curriculum policy implementation at the elementary school level.

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INTRODUCTION

The Indonesian government introduced the Merdeka Curriculum as an educational transformation effort to respond to 21st-century demands, which emphasize flexibility, project-based learning, and the development of students' competencies and character (Hikmah & Wiharja, 2025; Twin et al., 2024). This policy direction aligns with global trends that call for more adaptive, participatory, and contextual learning models (OECD, 2020). In addition, the initiative supports Sustainable Development Goal (SDG) 4, which highlights the enhancement of 21st-century skills, including digital literacy and adaptability in technology-enhanced learning environments (Nations, 2024; UNESCO, 2023). However, the reality of its implementation in elementary schools shows that both teachers and educational institutions continue to face numerous challenges. Previous studies have revealed that teachers still struggle to fully understand the core principles of the Merdeka Curriculum, particularly in designing instructional plans, selecting appropriate learning methods, and applying suitable assessment strategies (Awaliyah & Tiarina, 2023; Pebriani et al., 2025; Qonita

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et al., 2023; Wahyusi et al., 2025). Additional barriers are also evident in the limited availability of facilities and infrastructure, the increasing administrative workload, and the low utilization of educational technology to support project-based learning (Almarisi, 2023; Wahyuni et al., 2025).

In line with these findings, the challenges surrounding the implementation of the Merdeka Curriculum in elementary schools appear increasingly complex. At the practical level, many teachers are not yet prepared to design project-based or differentiated learning, which requires advanced pedagogical competence. Nurnaifah (2024) notes that many teachers struggle to develop innovative teaching materials due to limited experience, while research by Sucipto et al. (2024) shows that inadequate infrastructure and institutional support, particularly in the use of educational technology, further exacerbate the situation. These challenges are consistent with patterns reported in international literature. Darling-hammond et al. (2020) assert that curriculum reforms in various countries often fail to achieve optimal outcomes when not accompanied by continuous teacher professional development, including sufficient pedagogical training. This finding is supported by Voogt & Roblin, (2012), who highlight that although 21st-century competency frameworks recommend the active integration of technology in learning, implementation in schools frequently does not align with policy directions. The OECD perspective strengthens this argument by emphasizing that many countries fall short of modern curriculum goals because they overlook local contexts and the capacity of human resources in schools (OECD, 2020). Furthermore, analysis by Ertmer et al. (2012) indicates that technology integration requires not only technical skills but also shifts in pedagogical beliefs and school culture in order to enable meaningful use of technology. The TPACK (Technological Pedagogical and Content Knowledge) framework, as formulated by Voogt, Tondeur, and colleagues (Voogt et al., 2013) reinforces that effective technology integration demands simultaneous mastery of content, pedagogy, and technology.

Although challenges related to technology-based curriculum implementation have been widely discussed in global literature, similar conditions are evident in the implementation of the Merdeka Curriculum in Indonesia. Studies on the Merdeka Curriculum remain largely focused on macro-policy perspectives, while empirical research examining its classroom-level implementation in elementary schools is still limited. In a study by Hasballah (2024), the researcher found that most publications emphasize policy aspects, whereas practical challenges faced by teachers in the classroom tend to receive less attention. Putri & Mustika (2024) reported that limited infrastructure, diverse student needs, and low pedagogical competence serve as the main barriers for teachers in applying project-based learning. Saragih et al. (2025) further identified that the primary challenges faced by teachers are associated with limited instructional innovation, insufficient understanding of the curriculum, and lack of technology and supporting facilities. Difficulties in developing teaching documents, such as lesson plans and learning modules, also remain a significant issue. Yunitasari et al. (2023) added that many teachers continue to rely on conventional teaching approaches due to low technological proficiency. Meanwhile, Yusa et al. (2023) observed that although teachers generally hold positive attitudes toward the Merdeka Curriculum, its implementation is still hindered by limited mentoring, unclear technical guidelines, insufficient training, and high teacher workload. Similar conditions were reported by Reni et al. (2025), who emphasized the lack of research exploring teachers' ability to integrate technology, revealing a gap between policy expectations and classroom practice, and indicating an important research gap that needs to be addressed.

Based on this research gap, the present study seeks to offer a new contribution by directly examining how elementary school teachers implement the Merdeka Curriculum, particularly in relation to pedagogical readiness, the use of technology, and strategies for delivering project-based learning. This empirical focus on local classroom practices distinguishes the study from previous research that primarily emphasized policy analysis or conceptual discussions. A localized contextual approach is considered essential, as school environments and teacher characteristics have a significant influence on the effectiveness of curriculum implementation (Kasman & Firdaus, 2025; Rianti & Sujarwo, 2025).

Practically, this urgency highlights the need for strengthening strategies to support the implementation of the Merdeka Curriculum at the elementary school level, particularly through teacher capacity development and adequate institutional support. This research aims to provide strategic recommendations for elementary schools in improving teacher readiness, optimizing technology use, and creating a more adaptive learning ecosystem. This objective aligns with findings

by Aulia et al. (2025), who emphasize that the goals of the Merdeka Curriculum can only be achieved when teachers are able to integrate instructional innovations with supportive school environments. Similarly, Nurhairunnisah et al. (2025) stress the importance of structured mentoring to help teachers overcome pedagogical limitations and digital competency gaps. Therefore, this study offers a dual contribution: enriching the body of knowledge related to curriculum implementation in elementary schools and providing practical recommendations to enhance the quality of Merdeka Curriculum implementation.

METHOD

This study employed a descriptive qualitative approach combined with action research. The descriptive qualitative approach aims to gain an in-depth understanding of the initial conditions of the implementation of the Kurikulum Merdeka, particularly regarding teachers' readiness, the challenges they face, and the use of technology in the learning process. Meanwhile, action research is used as an intervention to improve teachers' competence in utilizing educational technology. This approach is chosen due to its reflective and participatory nature, which allows teachers to actively engage in the process of improvement. The action research model used refers to the stages proposed by Kemmis et al. (2014) which consists of planning, action, observation, and reflection.

Research Design

The design of this study is structured into two complementary stages: the descriptive qualitative stage and the action research stage. In the first stage, the study uses a descriptive qualitative approach to map the initial conditions of the implementation of the Kurikulum Merdeka in elementary schools. The findings from this stage serve as a basis for designing relevant actions that align with the needs of teachers in the field.

The next stage is action research, which focuses on intervention efforts in the form of training to improve teachers' competencies in utilizing educational technology. This action research uses the model proposed by Kemmis et al. (2014), which includes four stages: planning, acting, observing, and reflecting. In the planning stage, the researcher collaborates with teachers to develop a training plan based on the initial findings. Subsequently, the action is carried out through intensive training on the use of technology that supports the principles of Kurikulum Merdeka. The implementation process is systematically monitored through observation to assess teacher involvement, competency development, and the application of training outcomes in teaching activities. The reflection stage is conducted with the teachers to evaluate the outcomes of the actions, identify obstacles, and plan corrective measures for the next cycle.

With this dual-phase research design, the study not only focuses on describing existing phenomena but also aims at real improvement through direct action. This approach enables the research to produce comprehensive findings while also providing practical contributions to enhancing teachers' competencies in supporting the implementation of Kurikulum Merdeka.

Research Site and Participants

The research was conducted in three public elementary schools located in Tanjung Duren Subdistrict, West Jakarta, which have implemented the Merdeka Curriculum but continue to face challenges related to teachers' digital competence. The research participants consisted of core subject teachers who were actively using instructional materials aligned with the Merdeka Curriculum and agreed to participate in all stages of the study.

Instruments and Data Collection Techniques

The instruments used in this study were designed to support the two approaches applied, namely the descriptive qualitative approach and action research. In the descriptive qualitative stage, the instruments used consisted of interview guidelines, observation sheets, and documentation (Jamshed, 2014). The interview guidelines were formulated in the form of open-ended questions aimed at exploring the experiences, perceptions, and understanding of teachers regarding the implementation of the Kurikulum Merdeka, the challenges they face, and their skills in using educational technology.

The observation sheet was used to monitor teachers' activities in the classroom, including how they design and implement learning, the use of learning media, and their interaction with students. Observations were conducted with a non-participatory approach, where the researcher only observed and recorded relevant behaviors without being directly involved in the learning activities. Additionally, a documentation study was conducted on teaching materials, lesson plans, and project-based learning products to strengthen the data obtained from interviews and observations.

In the action research stage, the instruments used included a teacher competency assessment sheet on the use of technology, field notes, and teacher reflection journals. The competency assessment sheet was used to measure the improvement in teachers' competencies after attending the provided training. Field notes were used to record the dynamics that occurred during the training and the application of technology in the classroom. Teacher reflection journals became an important instrument to explore the teachers' subjective experiences related to successes, obstacles, and strategies used in utilizing technology to support learning based on Kurikulum Merdeka.

Data Validity Testing

Data validity was ensured through source triangulation, which involved comparing interview results, classroom observations, and document analysis (Flick, 2018). To evaluate the effectiveness of the training, the N-gain test was applied, providing a quantitative measure of improvement in teachers' competencies after the intervention (Hake & Reece, 1999). This approach strengthened the validity of the findings by integrating both qualitative and quantitative data.

Data Analysis Techniques

The qualitative data were analyzed through processes of reduction, categorization, and interpretation to identify themes related to the implementation of the Merdeka Curriculum (Creswell & Poth, 2018). The quantitative data were analyzed using the N-gain formula to assess the improvement in teachers' competencies. The results of both analyses were then integrated to provide a comprehensive overview of the effectiveness of the technology training in supporting the implementation of the Merdeka Curriculum. In addition, qualitative data from field notes and teacher reflection journals were analyzed descriptively to complement the quantitative findings, providing a contextual understanding of behavioral changes, technology implementation, and the strategies used by teachers in Kurikulum Merdeka based learning. With this dual analysis approach, the study is able to produce comprehensive, valid, and reliable data, while also demonstrating the tangible impact of the training on improving teachers' competencies in supporting the implementation of Kurikulum Merdeka.

RESULTS AND DISCUSSION

This study aims to analyze the improvement of teachers' competence in utilizing technology as part of the Merdeka Curriculum policy implementation at public elementary schools in the Duren Sawit area, West Jakarta. The results of improving teachers' digital competencies in utilizing technology as part of the implementation of the Independent Curriculum policy can be seen in Table 1.

Table 1. The Results of Pretest-Posttest

	Max Score	Min Score	Average score
Pretest	52.7	35.3	42.1
Posttest	88.3	75.8	81.9

The pretest and posttest results showed significant improvement after the intervention. In the pretest, the highest score obtained by participants was 52.7, while the lowest score was 35.3, with an average score of 42.1. This indicates that before the intervention, participants' competencies were still varied and mostly below average. After the intervention, in the posttest, the highest score increased to 88.3, while the lowest score was 75.8, with an average score reaching 81.9. This average increase of 39.8 points reflects significant progress in participant performance. To measure the extent of its impact, an N-gain test was conducted. The results of the N-gain test can be seen in Table 2.

Table 2. The Results of N-gain

	N-Gain	Category
Digital Competencies	0,69	medium

The N-gain value of 0.69 indicates a moderate improvement in digital competencies after the intervention. According to the N-gain scale, a value of 0.69 typically signifies a noticeable but moderate level of progress in the competencies being measured. This suggests that while there was a positive effect in enhancing digital skills, the improvement is considered medium rather than high.

This result implies that the participants have gained a fair level of proficiency in digital competencies, but there is still room for further improvement. Efforts to enhance digital skills could be further refined or expanded, potentially through more intensive or targeted learning strategies. In summary, the N-gain value of 0.69 demonstrates a positive shift in digital competencies, with moderate success in achieving the desired outcomes.

Analysis of the Implementation of the Merdeka Curriculum Policy

The results of the descriptive qualitative study conducted in several public elementary schools in Duren Sawit Subdistrict, West Jakarta, indicate that the implementation of the Merdeka Curriculum has generally progressed well and received support from various educational stakeholders. Teachers and school principals demonstrated commitment to adopting more adaptive learning approaches, while students and parents have begun adjusting to more flexible learning patterns. However, despite these positive developments, the implementation of the policy still faces several challenges that may hinder its optimization. Referring to Edwards III's framework, these challenges encompass four key aspects: communication, resources, implementer disposition, and bureaucratic structure (Edwards, 1980). This framework aligns with findings from previous studies, which emphasize that successful curriculum reform is influenced by clear policy communication (Irawan et al., 2024), availability of digital infrastructure (Safonov et al., 2022), teacher readiness and motivation (Syofyan et al., 2024), and the flexibility of bureaucratic systems in supporting educational change (Gavin & Stacey, 2023). Therefore, although the implementation of the Merdeka Curriculum in Duren Sawit shows positive progress, improvements in these four strategic dimensions remain necessary to ensure the sustainability and effectiveness of the policy implementation. The following discussion elaborates on the key aspects of policy implementation:

Communication

Communication plays a crucial role in the successful implementation of the Merdeka Curriculum, as this new policy requires significant changes in instructional practices and teachers' roles in the classroom. At public elementary schools in the Duren Sawit area, policy dissemination has been carried out through the Merdeka Mengajar Platform (PMM), webinars, and the Guru Penggerak program. These various communication channels were designed to distribute information regarding the principles, objectives, and implementation strategies of the Merdeka Curriculum to all teachers. However, the effectiveness of these communication efforts has not been evenly achieved. Younger teachers tend to understand digital-based information more easily due to higher levels of technological literacy, whereas senior teachers and some parents continue to experience confusion in interpreting the direction of the new policy. Differences in experience, technological adaptability, and the complexity of the policy content contribute to this gap in understanding.

In addition to differences in individual capacity, technical constraints such as unstable internet access have led some teachers to receive information only partially, resulting in incomplete and less optimal understanding of the policy. This situation highlights the importance of providing adequate supporting facilities, including reliable internet connectivity, appropriate digital devices, and technical assistance for teachers who face challenges in using online platforms. Furthermore, this condition demonstrates that communication in educational policy is not merely about disseminating information, but must also consider the readiness and characteristics of the information recipients. Therefore, a combination of digital-based dissemination and face-to-face mechanisms is necessary to support deeper understanding, provide space for clarification, and minimize misinterpretation.

These findings are consistent with previous research by Irawan et al. (2024), which emphasizes that message clarity, consistency, and appropriate communication channels are key determinants in the successful implementation of education policies. Rahmawati & Sujono (2021) also highlight that digital communication can expand access to information; however, it cannot fully replace face-to-face interaction, which is necessary to build trust and ensure accurate understanding. Sharma & Kumar (2025) assert that through effective and transformative communication, education systems can create an inclusive and future-oriented learning ecosystem, enabling the empowerment of learners, strengthening social quality, and fostering competent human resources capable of navigating global dynamics.

Therefore, the communication strategy for the Merdeka Curriculum needs to be adaptive, tiered, and continuous, particularly by considering variations in teachers' digital literacy and the availability of supporting infrastructure, so that the implementation process can run more effectively and consistently.

Resources

Resources serve as a crucial factor influencing the successful implementation of the Merdeka Curriculum in public elementary schools within the Duren Sawit area. Based on the findings, the resources in question include teaching personnel, learning media, instructional materials, and advanced technological support. The availability and quality of these resources determine teachers' ability to design, deliver, and evaluate learning in accordance with the principles of the Merdeka Curriculum. This finding aligns with previous studies indicating that the availability of learning facilities has a significant relationship with teacher performance effectiveness. The more adequate the facilities and access to learning resources, the more optimal the pedagogical practices that can be implemented in the classroom (Ogott et al., 2020; Zaini, 2024).

Interview and observation findings indicate that although basic technological facilities such as computers, projectors, and internet access are available and accessible to teachers, there remain significant challenges in utilizing these resources optimally, particularly in the use of Artificial Intelligence (AI). Teachers still experience difficulties integrating technology especially AI into lesson planning, instructional material development, and project-based assessment. As a result, the learning process continues to be dominated by conventional methods, limiting the realization of innovation opportunities envisioned in the Merdeka Curriculum.

Furthermore, this study reveals that the innovation potential offered by the Merdeka Curriculum has not been fully realized. The development of teaching materials and instructional media remains dominated by conventional methods, requiring teachers to invest substantial time and effort in preparing learning content without the support of automation or AI-based recommendations that could enhance efficiency and instructional quality. This condition contributes to low efficiency in lesson planning and limits teachers' opportunities to adopt more creative and adaptive pedagogical approaches. Overall, the findings indicate that the successful implementation of the Merdeka Curriculum in public elementary schools in Duren Sawit is strongly influenced by teachers' competency in utilizing technology, particularly artificial intelligence, to support innovative teaching and learning processes. Therefore, strengthening teachers' capacity in AI utilization and developing effective strategies for technology integration are essential to ensure that learning activities become more effective and aligned with the core principles of the Merdeka Curriculum. These findings align with studies by Vioreza et al. (2025) and Putri et al. (2025), which emphasize that digital literacy is a fundamental component of teacher competence, encompassing the ability to integrate technology into instruction, recognize potential digital risks for students, and foster a safe and technology-enhanced learning environment.

Implementer Disposition

The disposition of implementers is a crucial factor in determining the successful implementation of the Merdeka Curriculum, as teachers serve as the primary actors who influence the quality and effectiveness of learning. Findings from public elementary schools in the Duren Sawit

district indicate that implementer disposition encompasses teachers' attitudes, motivation, readiness, and commitment to executing the new curriculum. Results from observations and interviews show that teachers generally demonstrate strong motivation to apply the principles of the Merdeka Curriculum, including project-based learning and differentiated instruction tailored to students' needs. Younger teachers tend to be more flexible and quicker in adapting to new approaches, while senior teachers require additional time to adjust instructional methods and strategies in alignment with the curriculum requirements. Furthermore, teacher disposition is also reflected in their readiness to utilize educational technology, including the ability to operate digital tools and online learning platforms. Although basic technological infrastructure is available, some teachers still need to advance their skills in integrating AI and intelligent technologies into the teaching and learning process to ensure instructional materials become more innovative, interactive, and adaptive.

Teacher commitment is also demonstrated through their active participation in training and professional reflection. Teachers who are willing to engage in continuous professional development and evaluate their instructional practices exhibit a positive disposition and a strong orientation toward improving learning quality. Such disposition serves as a key determinant of successful Merdeka Curriculum implementation, as teachers are not merely executing procedures but are also capable of adapting instructional processes according to context, student needs, and ongoing pedagogical innovation. Thus, the successful implementation of the Merdeka Curriculum in public elementary schools in Duren Sawit is strongly influenced by the disposition of implementers, particularly teacher motivation, readiness, and commitment. Teachers with a positive disposition are more likely to implement the curriculum effectively, utilize technology optimally, and foster learning experiences that are high quality, innovative, and aligned with the core principles of the Merdeka Curriculum.

The attitudes and motivation of policy implementers in Duren Sawit demonstrate a generally positive trend. Teachers, principals, school committees, and students actively participate in implementing the Merdeka Curriculum, particularly in the Pancasila Student Profile Project (P5) program. However, the additional administrative workload associated with the program occasionally creates a sense of overwhelm among teachers. Despite this challenge, motivation remains sustained due to strong principal support and collaborative practices among teachers through peer learning groups. Aytaç (2021) emphasizes that teachers' intrinsic motivation plays a significant role in the successful implementation of a new curriculum, as intrinsic motivation directly predicts the accuracy and consistency of curriculum execution. In contrast, extrinsic motivation contributes indirectly through supporting factors such as organizational support, incentives, and work environment conditions. Furthermore, Vangrieken et al. (2015) assert that a strong culture of collaboration among teachers substantially enhances their confidence and readiness to navigate change.

Research conducted by Li (2023) shows that teacher resilience and self-efficacy have a negative correlation with burnout, indicating that teachers with higher levels of resilience are better able to cope with workplace pressures and demands without experiencing a decline in instructional quality. These findings reinforce that resilience is a crucial element in maintaining sustainable teaching practices, particularly when workload demands increase. This condition aligns with the results of the study conducted in public elementary schools in the Duren Sawit area, which revealed that intrinsic motivation and collaborative culture among teachers serve as key assets in the successful implementation of the Merdeka Curriculum. However, sustaining these practices still requires institutional support, such as reducing administrative burdens and providing non-material recognition, to ensure that teachers' commitment and endurance remain strong.

Bureaucratic Structure

The bureaucratic structure of schools plays a crucial role in either supporting or hindering the implementation of the Merdeka Curriculum. Findings from the study conducted in public elementary schools in the Duren Sawit area indicate that a clear organizational structure and well-defined

division of responsibilities facilitate effective coordination between principals, teachers, and administrative staff. Principals serve as supervisors and coordinators of curriculum implementation, while teachers are responsible for planning, delivering, and evaluating instruction. This structure enables policy directives from the education office to flow more efficiently and systematically to schools through formal communication channels. However, an overly hierarchical structure has the potential to slow down decision-making processes, particularly when rapid adjustments are required in areas such as project-based learning or technology integration. Some teachers expressed the need for more flexible communication mechanisms to ensure that pedagogical innovations can be implemented more effectively.

Bureaucratic coordination also influences the availability of facilities, training, and administrative support. A well-structured institutional system facilitates role distribution, enabling teachers to clearly understand their responsibilities in supporting curriculum implementation. Overall, the findings indicate that an organized and communicative bureaucratic structure serves as a supporting factor in the successful implementation of the Merdeka Curriculum. Schools that are able to balance formal procedures with operational flexibility tend to be more successful in applying the curriculum, facilitating teacher innovation, and improving instructional quality in the classroom. Therefore, the bureaucratic structure in Duren Sawit can be categorized as sufficiently supportive of the implementation of the Merdeka Curriculum.

These findings are consistent with Syifaurrahmah et al. (2025), who emphasize that a rigid bureaucracy has the potential to hinder the success of new curriculum reforms and therefore requires a more flexible design that can adapt to the context of each educational institution. Wermke et al. (2023) similarly found that bureaucratic systems that allow space for localized innovation enable schools to align policies with their specific needs. In addition, de Jong et al. (2025) highlight that horizontal coordination through the sharing of best practices among schools accelerates the adoption of educational innovation. The situation in Duren Sawit reflects this pattern, demonstrating that although a bureaucratic structure is already established and functioning, the successful implementation of the Merdeka Curriculum remains highly dependent on the system's capacity to adapt to local dynamics and its openness to cross-school knowledge exchange.

Enhancing Teacher Competence in ICT Utilization

The integration of Information and Communication Technology (ICT) is one of the key components in implementing the Merdeka Curriculum, particularly in fostering innovative and student-centered learning. Initial findings of the study indicate that prior to the training, most teachers in public elementary schools in the Duren Sawit area still relied on conventional learning media, such as printed modules, textbooks, and whiteboards. The use of digital platforms or Artificial Intelligence (AI)-based technologies in the planning, implementation, and evaluation of learning remained very limited. This condition aligns with the findings of Mapisa & Makena (2024), who assert that although teachers demonstrate positive attitudes toward ICT adoption, low levels of digital competence remain the primary barrier to its implementation in the classroom.

In addition to limitations in technical skills, teachers in the research area also experienced challenges in utilizing ICT for project-based learning and instructional differentiation. Many teachers reported lacking confidence in using interactive digital media, resulting in the underutilization of technology's potential to enhance student engagement and learning experiences. Özgür (2021) asserts that action research–based training can improve teachers' abilities to design digital learning tools while simultaneously increasing their technological self-efficacy. This is supported by Al-Samarraie et al. (2020), who found that teachers' ability to integrate technology largely depends on hands-on experience, professional mentoring, and institutional support from schools. A number of studies highlight that teachers' technical and pedagogical readiness is a determining factor for the successful integration of educational technologies in schools. Ertmer et al. (2012) emphasize that teachers with adequate digital readiness are more capable of creating interactive learning environments that align with student needs. Similarly, Yeh et al. (2015) identify that the success of ICT integration in primary or secondary schools does not solely depend on the availability of

technological tools, but more importantly on teachers' competencies and their contextual implementation experience.

To address these challenges, this study implemented a series of steps, including a pre-test, training and mentoring sessions, and a post-test. The training focused on three main aspects: designing digital-based instructional media, utilizing social media for learning, and using search engines to locate relevant teaching materials. The results indicated a significant improvement, where the teachers' average scores increased from 42.1 (pre-test) to 81.9 (post-test) (see Table 1). The N-Gain test yielded a score of 0.69, categorized as effective, demonstrating that the training intervention had a substantial impact on enhancing teachers' digital competencies.

These findings align with the meta-analysis conducted by Morina et al. (2025), which concluded that online professional development consistently improves teachers' pedagogical and technical skills, although its impact on student learning outcomes tends to emerge gradually. Similarly, Abraham et al. (2022) found that ICT-based training not only enhances teacher competence but also expands innovative instructional practices in the classroom. Beyond competency aspects, psychological factors also play a crucial role in the adoption of educational technology. Viberg et al. (2024) demonstrated that teachers with high levels of self-efficacy in using technology, including AI, are more likely to confidently integrate it into their instructional practices. Meanwhile, Nettey et al. (2024) emphasized that the success of ICT integration is strongly influenced by the availability of adequate infrastructure. A similar condition was observed in the context of this study, where limited devices and unstable internet connectivity remain ongoing challenges. Therefore, strengthening teacher competence through training must be accompanied by sufficient infrastructure support to ensure sustainable outcomes.

Overall, the findings of this study confirm that improving teachers' ICT competence has a direct impact on the effectiveness of implementing the Merdeka Curriculum. Teachers with strong digital skills are able to design learning models that are more interactive, collaborative, and aligned with the characteristics of digital-native students. Thus, continuous ICT training programs, adequate digital infrastructure support, and strengthened psychological readiness among teachers serve as key strategies to ensure the success of instructional transformation.

LIMITATIONS

This study has several limitations that should be acknowledged. First, the research was conducted in only three public elementary schools within the Duren Sawit area, which limits the generalizability of the findings to broader school contexts with different characteristics, resources, and policy readiness levels. Second, the improvement in teachers' digital competence was measured within a relatively short intervention period, so the study could not capture the long-term sustainability of teachers' skills or whether these competencies are consistently applied in daily classroom practice. Third, the assessment of teacher competence relied mainly on pretest–posttest scores and qualitative reflections, without incorporating classroom-based student learning outcomes, which could provide a more comprehensive picture of the impact of technology integration. Fourth, the study did not evaluate differences in teacher competence based on demographic factors such as age, teaching experience, or prior digital exposure, which may influence the effectiveness of the intervention. Finally, the study focused on basic technology use and has not yet explored deeper integration of advanced digital tools such as AI-based applications or learning analytics, which are increasingly relevant to the Merdeka Curriculum. Future studies are recommended to address these limitations by involving more diverse school settings, applying long-term evaluation designs, and examining the impact of technology integration on student learning outcomes.

CONCLUSION

This study indicates that the implementation of the Merdeka Curriculum in primary schools, particularly in the Duren Sawit area of West Jakarta, continues to face various challenges, especially regarding teachers' readiness to design differentiated learning, utilize technology, and overcome limitations in facilities and infrastructure. However, through an action research approach involving training and mentoring, teachers' digital competence can be significantly improved. The results of the N-gain analysis demonstrate that practice-based training effectively enhances teachers' skills in

designing digital media, using interactive technologies, and managing project-based learning. Thus, the successful implementation of the Merdeka Curriculum is strongly influenced by three key factors: (1) strengthening teachers' digital literacy through continuous professional development programs, (2) providing adequate infrastructure and supporting facilities, and (3) establishing a collaborative school ecosystem to reinforce teacher motivation and commitment. These findings emphasize that learning transformation in the era of the Merdeka Curriculum requires not only policy shifts but also systematic strategies to enhance teacher capacity and ensure sustained institutional support.

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